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Caroline Ignell, Peter Davies, Cecilia Lundholm

Understanding 'Price' and the Environment: Exploring Upper Secondary Students' Conceptual Development

- Differences between everyday and scientific conceptions of environmental issues in pricing are identified.
- Upper secondary students in this study were more likely to refer to production issues than consumption issues in their conceptions.
- Even after studying economics, students' conceptions seemed to be in a state of flux.
- Although conceptions of how prices were determined and how they should be determined were separated into categories with a similar structure, students tended to be inconsistent in their conceptions.

Purpose: To explore changes in upper secondary students' conceptions of environmental issues in how prices are determined and how they should be determined.

Design: The study uses an 'alternative frameworks' conceptual change approach to examine change in the conceptions of fifteen business and economic students. Students were asked about the prices of familiar products and asked to explain prices for eco-friendly and eco-unfriendly products. A first interview was conducted in the second year of education and the second interview a year later when students were 18 years old and in the final year of schooling. Interviews were carried out by a researcher independent from the schools and carried out in schools.

Findings: Identifies the fragmentary nature of students' every-day thinking in relation to productivity, consumer preference and negative externalities. Results show characteristics of partial conceptions, which are considered as students' conceptions in a process of change towards a more scientific understanding of relationships between price and environmental impacts.

Practical implications: The study clarifies conceptions, which students bring to the classroom and the directions that development in understanding may take. The study should help teachers to design effective strategies to support students' learning.

Keywords:

Price, externality, sustainability, longitudinal study, economic and environmental education

1 Introduction

We investigate changes in upper secondary pupils' explanations of price in relation to the environment through a qualitative longitudinal study. The study is premised on a belief that students' conceptions of environmental considerations in price matter for the extent to which citizens are able to exert a well-informed influence on economic policy towards sustainability (Davies, 2006; Davies, 2015). This study follows earlier work (Ignell, Davies & Lundholm, 2013) that reported infrequent and inconsistent references to environmental factors in the students' explanations of price differences between several goods. The present study addresses three

questions: What differences are there between students' conceptions of environmental issues in pricing after one further year of education in upper secondary school? What differences - before and after given information regarding environmental issues and after one further year of schooling - are there between students' explanations of how prices *should* be determined? What differences are there between conceptions that are evident in student explanations of how environmental issues *are* reflected in prices and judgments about how environmental issues *should* be reflected in prices? We explore how students' different conceptions change over a year's time, during the two final years in a business and economic education program in three Swedish upper secondary schools.

The next section of the paper addresses the theoretical background and evidence of students' environmental and socio-economic conceptions. This is followed by a description of the study's design and analysis. The results section starts by presenting evidence of students' thinking about how environmental impact and pricing are determined and continues by showing findings of changes in students' conceptions. Our discussion considers implications for teaching and learning in business and economic education.

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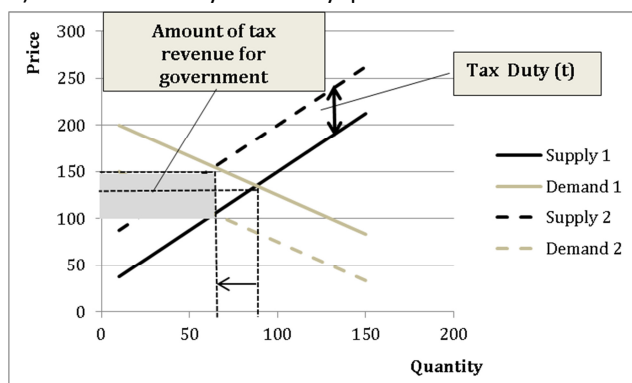
1.1 Background

This section sets our study in the context of environmental externalities and conceptual change. Market prices underestimate costs of production and consumption when there are negative environmental impacts (such as pollution of natural environments) which are known as externalities (Gravelle & Rees, 1992; Owen, 2004; Tietenberg & Lewis, 2009). One possible response to this problem is to prevent forms of production/consumption that generate environmental damage. This prevention will typically take form of regulation backed by law. From the standpoint of neo-classical economics this may well result in a loss of welfare since there is likely to be some level of environmentally destructive production which yields sufficient benefit that most people would prefer to live with the damage done than to give up what is produced.

A second response is to aim for a price and output level that would arise if the market took account of externalities. This may be achieved by tax and credit systems, which adjust rather than eliminate environment-degrading production (see Figures 1(a) and 1(b)).

Figure 1. Supply and demand responses to environmental externalities

a) 'Environmentally unfriendly' product



b) 'Environmentally friendly' product

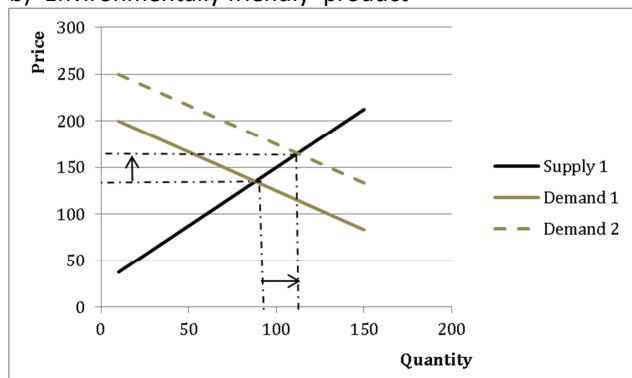


Figure 1(a) shows how a tax per unit (t) which is equivalent to the level of externality at the equilibrium price shifts the supply curve upwards, raises the equilibrium price (by less than the rate of the tax) and raises tax revenue (shaded area) for the government. In principle, a similar fall in production could arise if consumers fully internalise the externalities i.e. by increasing their

demand for environmentally friendly products and thereby move away from more harmful activities. In this case (Figure 1a), demand for the 'environmentally unfriendly' product falls from D1 to D2 as consumers switch to the 'environmentally friendly' product (Figure 1b). In this case there is no tax revenue.

Socio-economic aspects of beliefs about environmental sustainability have received limited attention within the research literature on students' conceptual change and few studies have examined conceptual formation (Lundholm & Davies, 2013). Nonetheless, the powerful normalising effect of students' experience and dominant beliefs in their society have emerged as themes in studies of pupils in China (Sternäng & Lundholm, 2012) and England (Davies & Lundholm, 2012). For example, students' attending 'Green Schools' in China commonly expressed a belief that environmental problems were unavoidable when developing an economy, but economic growth would enable these problems to be overcome in the future. However, in the English study, some of the students believed that markets did not offer an automatic solution to environmental problems. For example, students argued that there would be over-consumption of products when prices do not reflect externalities.

An important notion in our study is that we approach students' understandings in terms of alternative frameworks, rather than misconceptions, meaning that individuals' understandings of a scientific phenomenon can be held in parallel and understood as alternative, to a scientifically correct, way of understanding (Driver & Easley, 1978). Larsson and Halldén (2010) have shown, from repeated interviews with children on the concept of earth, how various conceptions might shift during the same interview. Furthermore, over a period of 3 years, the children's conceptions are shown to be integrated as well as differentiated into new conceptions. These findings suggest that individuals might hold multiple and parallel understandings, explained in terms of multiple frameworks, of a scientific phenomenon. On the basis of their experience, students will develop conceptions of price and the environmental consequences of production and consumption. Here, we are interested in comparing these conceptions with the conception embodied in Figure 1.

Research in conceptual change has captured changes in students' understanding through tests and/or interviews before and after teaching interventions. Our study focuses on differences between students' conceptions at age 17 and age 18 years. In the year between the two interviews, students followed a study programme in business and economics. As mentioned, our study examines (i) differences between conceptions of environmental impacts on pricing after one further year in upper secondary school; (ii) differences between explanations of what prices *should* be before and after being given additional information regarding environmental impacts, and (iii) differences between conceptions evident in explanations of how environmental

impacts *are* reflected in prices, and judgements about how environmental impacts *should* be reflected in prices.

2. Method and analysis

This study uses a longitudinal design and follows the same students *through time*. The premises are that analysing change requires at least two reference points through time and we follow Saldaña (2003) in seeing change as a process outlined in the terms *from-through* rather than *from-to*. The first phrase conveys a sense of unfinished change, which is still in process and this description is more apt for the data we present in this study. The following section describes the participants and the procedure of our data collection, followed by an outline of the analysis process before the results are presented.

2.1 Participants

Data were gathered from students aged 17 and 18. All participated in Sweden's national business and economic educational programmes, and were studying subjects such as business economics and international economics in addition to mandatory courses e.g. in civics, science and geography. The students came from three different upper secondary schools in a mixture of urban and non-urban localities. A sample of 16 participants (eight female) volunteered for and attended the first interview. One student did not participate in the second interview and two students did not participate in the last part of the first interview. The research design followed ethical guidelines regarding consent; the de-identifying of interviewees, disclosure and data security (Gustafsson, Hermerén & Petersson, 2011).

2.2 Data collection

Students were interviewed twice and each interview lasted about 30 minutes. The first interview took place in mid springtime and the second interview was roughly one year later when students were in their final study year. Each interview explored elaborated thinking through dialogue in an informal setting between the interviewer and the student (Mishler, 1986). This means that students' thoughts about specific issues were discussed along with personal experiences of purchasing the associated goods and services. During the second interview, each student was also asked to state what he/she recalled from the previous interview. The interview settings were the same in both years, namely; conducted with the same interviewer and the same students, in the same schools and during the months of March and April. The interview questions and structure were also the same during both occasions, with consistency in products (beef-burgers, taped/untapped water, flight and train services) to be elaborated on and questions focused on students' conceptions about pricing. In this paper we focus on students' thinking about beef-burgers.

2.3 Interview design

Table 1 presents an overview of the two interviews. The interviews followed the same guideline each year and were conducted by the first author.

Table 1: Interview format of the first and second interviews

1. Do you sometimes buy a beef burger? If so, how often?
2. Are there differences in price between burgers that are more environmentally friendly and those that are not? Describe, what are the prices?
3. Does this surprise you?
4. Why is it like this?
5. What influences these prices?
6. Are there other factors that influence price? (This question was repeated several times during the session to assure the student got the opportunity to present all possible causes to prices he/she could think of.)
7. What *should* the prices for the beef-burgers be? If you could decide.
8. Is there anything additional that *should* influence the price?
The interviewer presented information specifics of negative impact (see Appendix 1) related to beef-burgers on a laptop and after this the seventh question was repeated somewhat modified.
9. Is this something that *should* influence the prices for the beef-burgers, when you have seen this information?

After the second interview the student was asked if and how pricing had been part of the education.

The interviews focused on students' conceptions of how price *is* determined and how prices *should* be determined for eco and regular beef-burgers. This example was chosen partly because we believed that 'buying beef-burgers' is part of the common experience of most Swedish students. Beef-burgers were also chosen to build on results from previous studies. Ignell et al., (2013) asked Swedish secondary school students (using an open-ended questionnaire) 'What possible reasons there could be for a burger bought from one restaurant having a higher price compared with a burger bought from a different restaurant?' Just over 20% of the students referred to environmental impacts in their answers. A minority of the students also referred to environmental considerations in terms of customers being willing to pay more for an 'ecological product'. However, an English study (Davies & Lundholm, 2012) found little evidence of thinking about externalities in students' judgements about the appropriate price for a beef burger compared to other goods. This might reflect differences between the national contexts. The Swedish media have focused on beef production as a cause of global warming, and some school-cantinas have introduced 'Meat Free Mondays'.

Our interest in students' verbal thinking about how prices *should* be settled was included in this study given results in previous work (Ignell et al., 2013). In that study, students often reasoned differently according to whether they were explaining how prices were determined or suggesting how they *should* be determined. In the last

section of the interviews, the students were given information about environmental impacts from beef production and asked if the described effects *should* be affect price. The information was aimed to provide the students with a specific context through which they could express their understanding, thus overcoming difficulties of an abstract phenomenon such as externalities (Berti & Bombi, 1988). More specifically, the information, which was presented in two short extracts, could elicit conceptions not brought forward in the previous elaborated content. The information was chosen because it highlighted some key processes through which production impacts on the environment and estimated the scale of these impacts.

2.4 Analysis

All interviews were recorded and transcripts were written with short facilitating words (such as *okay*, *I see*, and *yes*) omitted. We used thematic analysis of students' thinking about environmental impacts and pricing to identify different patterns in students' thinking (Braun & Clarke, 2006). The analysis started with manual coding and grouping of transcriptions to identify essentials parts of the interviews with reference to negative environmental impact in relation to how prices *are* respectively *should* be constructed. The coding procedure was partly data-driven in that the process depended on our interview data. However, this procedure was also theory-driven, in that we approached the data based on understandings from earlier research by Dahlgren & Marton (1978). They reported patterns of how the price of a bun is conceptualized by university students in qualitatively different ways; in terms of price decided from supply and demand or its intrinsic value. In the following part of the analysis we organized the different codes into themes, from how pricing was described and concluded in the two themes of price influence; i) production methods - the inputs and costs for producers and ii) consumers' requests and preferences. We labelled these themes Productivity and Consumer preference in organising our data. In the following phase we identified levels within our themes that suggested some progression in students' thinking. The results were then discussed and agreed among the authors in line with a recurrent inter-reliability process. Aspects of the data of each level are presented in the next section and followed by a summarizing of the papers' findings.

3. Results

There are four main results sections. The two first sections present different conceptions of environmental impacts and pricing and changes in these conceptions through time. The two last sections describe changes in conceptions of how prices *should* be determined and differences between conceptions evident in explanations of how environment impacts *are* reflected in prices and judgements about how environmental issues *should* be reflected (that is after given information of negative impact from production). We differentiated between the complexity of conceptions through different levels of

complexity: *basic*, *partial* and *complex*. These labels are intended to convey the sense of transition (partial) everyday (basic conceptions) and more scientific (complex conceptions). In each table we have attached short and elaborated content descriptors to the categories of conception. These conceptions are exemplified through students' excerpts.

3.1 Conceptions of negative environmental impact in relation to price

Thirteen of the fifteen students that participated in both interviews made environmental connections in their thinking.

3.1.1 Productivity and negative environmental impact

The results show three different levels of productivity (Table 2).

Table 2: Levels of thinking about productivity

<i>Basic</i>	Eco = higher cost	Eco goods are more expensive because they are more costly to produce.
<i>Partial</i>	Eco = more resources = higher cost	Eco goods require more resources in their production and this makes them more expensive (the productivity principle).
<i>Complex</i>	Eco affects resources in two ways (short term and long term)	Eco goods are more expensive because they use more resources that have to be paid for (like labour) but they conserve the natural environment (either a capital argument or a holistic view of the environment argument).

Basic conceptions suggested that the higher price of the eco beef-burgers was related to the use of less chemicals and to lower emissions. These explanations offered no indication of *why* not using chemicals would add to cost of production. This conception is illustrated in the following exchange:

"Maria: Well, one does not use chemicals (to produce eco-beef burgers) and a lot of stuff ...

Interviewer: And how is that influencing the price of the burger?

Maria: I think it perhaps gets more expensive.

Interviewer: Okay, why is it like that?

Maria: It is because one does not grow it in a regular way.

Complex conceptions of productivity explicitly related the cost of production to the use of resources.

Rolf: I would say that it is more expensive with eco-friendly beef burgers for you need to ... take longer, to probably get resources ... and that takes more time if you are into special fodder and stuff for the animals and ... then it is also ... it takes a longer time ... when you consider the environment, I would say.

... I suppose the eco ones would be more expensive because in most cases, it's cheaper to do something and not care about the environment and not consider the environment. Because there is no need to use resources for

reducing impact and ensure that they do not contaminate which calls for extra work most often.

This explanation argues that producing environmentally friendly burgers incurs more costs because it uses more resources. It recognises that other forms of production have negative consequences for the environment, although it does not explicitly refer to how these consequences might be valued or that they involve a loss of resources.

We identified other *partial* conceptions of productivity that suggested an understanding that was in transition between the *basic* and *complex* conceptions. For example:

Martin: So if we want to have eco it is more expensive since one pay for the environment.

Interviewer: What is it that you pay for?

Martin: For the nature to be well... if you should take care of nature it costs money.

Interviewer: Why is that?

Martin: Well it is really difficult ... One has first to think of what the meat, what the animals eat... Transport does also influence to some part. It is probably what the raw material costs and the profit and if it is eco sound it probably costs more. It costs more to take responsibility and recover the nature... well to make it easier for the nature to get in the right phase, which has been influenced when one takes out the natural resources.

In the first part of this exchange Martin expresses a similar conception of production to Maria. However, he is also beginning to express the idea of an externality: referring to the economic (market) system as encouraging ‘cheap’ production, whilst the environment is ‘something you have to pay for’. Moreover, in the final part he begins to express how forms of production may affect cost. Some indications of his uncertainty are conveyed by ‘influence to *some* part’ and ‘*probably* what the raw material costs’. Although he is beginning to develop a conception of relationships between production and cost he is not yet explicitly thinking in terms of productivity: the ratio of inputs to outputs. Comparison of students’ utterances did not provide firm grounds for believing that some were thinking about productivity and resources for a single firm, whilst others were thinking in terms of market supply. Future research might examine what prompts students to recognise this distinction.

3.1.2 Consumers’ preferences and negative environmental impact

We distinguished between two different levels of consumer preference and Table 3 outlines *basic* and *partial* conceptions of environmental impacts and consumer demand.

Table 3: Levels of thinking about consumer preference

<i>Basic</i>	Single demand argument: willingness to pay	People value eco and will therefore pay higher price (demand matters).
<i>Partial</i>	Two relationships between demand and price.	If the price is higher people will want less of it, (movement along demand curve) and if everyone wants more of something it will tend to put the price up (shift in demand) (price influenced by market demand and its interaction with supply).

We categorised conceptions as *basic* if they suggested that some consumers would be willing to pay a higher price for eco-burgers.

Rolf: It may well be that the personal approach that some people might be willing to pay more if they know that it is environmentally-friendly made... they have a higher price just because they can do it.

Interviewer: If you develop it a little bit ... if you are willing to pay more for a product ... it can be more expensive ... is that what you think?

Rolf: That may be the fact, definitely, that can influence, when they price the product.

Interviewer: How do you think about this?

Rolf: So, people would rather buy something that they know ... so they do not get a bad conscience about the environment, so, they know it is made properly so they want to pay a higher price in order to avoid it (bad conscience).

Although this explanation starts by referring to ‘some people’, it is really dividing people into those who are willing to pay more and those who are not. There are two types of individual in this thinking rather than a market demand which is a continuous negative relationship between price and demand reflecting variation in what people are willing to pay and how many of them that are willing to pay each price.

We found no utterances about consumer preference which we could classify as *complex*. However there is a way of conceiving a *complex* understanding of consumer preference in relation to negative impact and it is suggested in the economic literature that; some consumers value the production’s impact on the environment and are willing to internalise externalities by paying a higher price, to encourage production of eco-friendly goods. This increases demand for these products so that a higher price is associated with greater production. Price is thus influenced by market demand and its interaction with supply and consumers’ internalisation of externalities (Brown, 2001; Tietenberg & Lewis, 2009). This is illustrated in Figure 1b.

We also identified some conceptions as *partial* because they provided some evidence of starting to think of price as a ‘market’ phenomenon and some evidence of starting to distinguish between movements along a demand curve and shifts in demand (without explicitly formulating the ideas in these terms).

Manfred: Well, it is like... what I am thinking of is perhaps the demand.

Interviewer: Well, okay, what is that?

Manfred: Well, that is simply how much people buy of a product.

Interviewer: Mm, how is that influencing the price?

Manfred: Well, that depends on. In many cases, like if there are a lot of people who want to have the product, the price is raised because people buy it anyhow, however, sometimes one reduces the price simply because people buy the cheapest alternative. That is usually how it is for food... Yes, people's mentality so to say. It is probably those who decide if they are going to buy it or not. It has probably to do with demand I assume.

Although this explanation does not express any explicit idea of a market demand there are references to the responsiveness of price to how many people will buy the product and the responsiveness of demand to changes in price. These ways of thinking imply a market in a way that it is not apparent in Rolf's explanation.

3.2 Changes in conceptions of how prices are determined

In the previous section we have described and exemplified the levels of conceptions. In the following part we present changes between the levels we found between the first (T1) and second (T2) interview. This answers our first research question. Our main observation is that there was very limited change in the thinking of this group of students. Four students provided evidence of conceptual change: in each case the change was in thinking about productivity. We found two types of change: *basic to partial*, and (one student) *partial to basic* conceptions (see the overview of changes in Table 4).

Table 4: Overview of conceptual differences

	Ellen, Marcus		Felix, Martin, Ronja		Herbert		Kristin		Manfred		Maria		Mark		Rasmus		Rolf		Vilma	
	A				A		B		B		B				B					
Environmental references	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2
Productivity																				
Basic								*	*		*		*		*		*			
Partial	*	*	*		*	*	*			*		*		*		*				*
Complex																	*			
Consumers																				
Basic															*		*		*	
Partial									*			*								
Complex																				
No environmental references				*											*			*		

A: No conceptual differences over time.

B: Characteristics of conceptual differences that include partial productivity conceptions.

3.2.1 Change from basic to partial productivity conceptions

Three students shifted from a *basic* to *partial* conception of pricing concerning productivity. An example is provided below. At T1 Maria asserted that eco-burgers are more expensive than non-eco burgers because they are not produced with chemicals. She offers no rationale for this connection. At T2 she does offer a rationale in terms of the 'time needed' to produce eco-burgers. She makes no explicit reference to costs, so we have interpreted this as an idea which is not yet fully formed and

therefore categorised as 'partial'. She also refers in T2 to 'taking care of things' when producing eco-burgers implying, but not clearly stating, that eco production demands more resources like labour in order to conserve the natural environment.

Maria (T1)

Productivity (basic)

Maria: Well, one does not use chemicals (to produce eco-beef burgers) and a lot of stuff ...

Interviewer: And how is that influencing the price of the burger?

Maria: I think it perhaps gets more expensive.

Interviewer: Okay, why is it like that?

Maria: It is because one does not grow it in a regular way.

Maria (T2)

Productivity (partial)

Maria: Well ... more time is needed for the eco compared to the non-eco goods, so one does not think of ... chemicals ... and how one produces the goods... I think more time is needed for the eco burger ... one thinks more of the effects from the emissions, one takes care of lots of things and that influences the price.

3.2.2 Change of environmental references in relation to consumer preference

Students made fewer references to consumer preferences than to productivity. Five individuals referred to consumers in the first or second interview by stating that the price of eco beef-burgers is influenced; by consumers who prefer animal care, eco-labelled goods, or who believe they are doing climate-smart actions when paying higher prices. No student referred to consumer preferences in both interviews hence we found no changes across time in sophistication of conception of consumer preference.

3.2.3 Environmental references in relation to combining productivity and consumer preference

Four students referred to both productivity and consumer preference in their thinking about prices. For instance, one student (Mark) presented a *basic* theme for production reference and *partial* theme for consumers' preference in his first interview. Another student (Rolf) expressed a *complex* conception of productivity and a *basic* conception of consumer preference. Two other students combined two *basic* respectively two *partial* levels.

In summary, whilst we found one example where a student expressed a more *complex* conception in the second year, the overall picture suggested tentative and transitional change at most. The changes we observed were restricted to students' conceptions of the role of productivity and externalities. Some students only talked about price and the environment in one of the two interviews. Although all these students were following a course in business and economics in their final two years of schooling, there was no evidence of consistent change in conceptions of price and environmental effect.

3.3 Conceptions of what prices *should* be - prior to and after receiving information about biodiversity loss and climate change

When presenting the results concerning the second research question we focus on student views on how prices *should* be determined. We also examine differences in expressed views before and after receiving written information about environmental impacts of production and distribution (Appendix 1). Nine students made environmental connections before and after given information in the first and the second interview, and these students are included in the analysis. In this section we concentrate on the thinking of these students.

Table 5: Themes and levels for how prices *should* be determined.

	Theme of qualitative level	Productivity	Consumer preference
<i>Basic</i>	Compensation	Non-eco goods (eco-unfriendly beef-burgers) <i>should</i> be more expensive because they generate negative environmental impact.	People should value eco friendliness and they should pay a higher price. (or) People prefer to buy less expensive goods therefore eco should be cheaper.
<i>Partial</i>	Externalities	Emissions and other environment harming actions create a cost, which <i>should</i> be included in the price (to reflect the total value of resources used). (<i>Externalities</i>)	People should value eco friendliness when they get information of the negative impact and price will be reduced since high demand reduces the price (no reference to changes in supply).
<i>Complex</i>	Price should reflect externalities and effects on resources	Non-eco production, which damages resources, creates costs that would not be included in the price unless there is, for example, a carbon tax. (<i>Combines productivity and externality arguments.</i>)	

We found three different views of how prices *should* be: eco *should* be more expensive, non-eco *should* be more expensive, and the two types of beef-burgers *should* have the same price. The arguments for these are analysed in terms of *basic* and *partial* and presented in

the following text exemplified by students' quotations. These conceptions follow the study's earlier analysis that described how prices *are* formed within the two main-themes; 1) by productivity references and 2) by consumer preferences.

3.3.1 Differences between 'pre-information' and 'post-information' conceptions

We identified two differences (a and b) between views expressed before and after the information was presented. We label these in terms of 'pre-information' and 'post-information'.

a) From consumer preference to productivity references

Manfred, pre-information, T1

Basic level of consumer preference: eco should be cheaper because that is what people purchase.

Interviewer: If you could decide, what should the prices be for the Eco and non-Eco beef-burgers?

Manfred: Well, if it were possible it should have been (be) like a reversed situation and the eco should be cheaper and ... people would start to buy more of the eco-goods and become aware of this (that non-eco have an impact to the nature).

...

Manfred: Yes, it is not doable to change the price right away ... it has to happen gradually and ... But in the long run I think that it should be cheaper than conventional meat.

Interviewer: Why is that the case?

Manfred: Yes... first, people buy what is cheapest, and then it is good for the environment also.

Manfred, post-information, T1

Partial level of productivity: non-eco should be more expensive because of the future risks they generate.

After that information was given and the follow up question posted 'Do you thinking this is something that *should* be included in the price?' Manfred responded 'Yes, of course' and the interview continued to elaborate on the opinion.

Interviewer: If I understand you correctly, you think this negative environmental impact should be... part of the price of the burger?

Manfred: Yes if one could decide... one has to have a long-term view also. In the short turn it is cheaper to buy the ordinary burger, but in the long run...

Interviewer: What do you mean by that?

Manfred: Yes, the environment as such. The greenhouse gas effect and all that and we hear about... global warming, will lead to negative consequences.

Interviewer: Do you have any particular consequences in mind?

Manfred: Yes, the temperature is increasing and that leads to, well we have seen what it is like in the Sahara desert... for sure that has taken some more time, but if you think for a few hundred years ahead, maybe there will be tropical climate here by then. Then growing crops will not be as easy and so on.

b) From productivity to combining productivity and consumer preference

We use extracts from interviews with Felix to exemplify this change.

Pre-information, T1

Before reading the information, Felix expressed a *basic* conception of productivity, referring only to environmental damage from non-eco production.

Interviewer: What should the prices be for the both types of beef-burgers if you could decide?

Felix: Well, I think they should only produce the eco, or, well, what can I say, because otherwise we destroy the environment... so you have to reduce the price for the eco-burger to get better.

After reading the information (T1) Felix refers again to environmental damage but also comments on consumer preferences. He still does not refer to the cost to the supplier of the non-eco production and does not relate consumer preferences to the price they are willing to pay, so the conception expressed here is still classified as *basic*.

Interviewer: Is this something that you think should influence the price?

Felix: When they use chemical pesticides... that could harm the environment and so on. Nowadays people do not care about the environment, except in Europe, but the people selling goods here (in Sweden) import from other countries where they use chemicals, and for instance clothes, from other countries' manufacturing, however it is still this planet we live on.

Interviewer: So you think the eco-burger should be cheaper compared to the conventional?

Felix: Yes!

However, these differences before and after the provision of information do not mean that the information simply forces students to adopt a particular change of focus. If information forced a particular change we would expect each student to change their thinking (from before to after the information) in the same way in Year 2 as in Year 1. In fact, two students changed their thinking in the same way in both years (following a) and only one did not change their thinking at all in either year (in response to the information). To illustrate this comparison of changes between Years 1 and 2 we focus on Maria's descriptions.

Before the information, Maria focused on consumer preferences, although her thinking fell into our *basic* level. She also answers the question in terms of 'what would make people buy more eco-burgers' rather than directly framing her answer in terms of 'what *should* happen?'

Maria, pre-information, T1

I: What should the prices be for the beef-burgers?

M: I think eco should be expensive or (rather) if people shall buy it, it should probably be cheaper, - so people buy them, well I don't think they (the buyers), that so many think of eco (but) if it is cheap they will buy it.

After reading the information she expressed concern about the long-run production implications of non-eco-friendly farming (asserting 'species could die out' and that this could lead to the price of meat getting higher in Sweden). The interviewer then asked her about whether her concerns for the future *should* have any impact on current prices.

Maria, post-information, T1

I: So when you think of this negative impact, it is something that should be included in the pricing of beef-burgers? And it should be ...

M: More expensive!

I: And who do you think should pay this extra cost to take care of the environment?

M: It is probably we.

I: What do mean by this?

M: Well, all of us that buy the beef-burgers from the shops you know.

As in Time 1, before reading the information, Maria shifts between answering the question in terms of 'what is the case' and 'what *should* be the case'. She also focused on productivity rather than consumer preferences, though her thinking was still at a *basic* level.

Maria, pre-information, T2

Interviewer: How do you think prices should be determined?

Maria: Regular (non-eco) burgers are cheaper because one does not put that much time to (produce) it and that should people get to know before they buy the regular burger.

Interviewer: What do you mean by this?

Maria: Well I do not know how the process ... I think some give more time to the eco burger, like if one thinks more of the effects from the emissions, one takes care of lots of things and that influences the price.

After reading the information she repeated the concern she had expressed, post-information, in Year 1, that non-eco friendly production would reduce bio-diversity. However, this time she argues that consumers *should* respond to the risk of species reduction by buying more eco-friendly burgers. However, she believed that this would *reduce* the price of eco-friendly burgers. She does not articulate the consumer preference argument in which consumers internalise negative externalities by being willing to pay more.

Maria, post-information, T2

Maria: If more people (should) buy the eco beef-burger they help to reduce the negative impact and there will not be that much reduced biodiversity. Interviewer: So if more people buy the eco beef-burger the emissions will be

reduced ... and how is that influencing the price – that more people buy eco?

Maria: The price will be reduced since high demand reduces the price... if they get more information about how the nature is influenced.

In summary, we find that the additional information was associated with a rich variation in individuals' changes between conceptions from T1 to T2 and also during the interviews. This can suggest that information about environmental impacts prompts different aspects of individuals' conceptions of links between pricing and the environment. Between T1 and T2, all students, except three, offer different views of how prices *should* be determined. Students express arguments for a higher price in relation to different levels of productivity only, or consumer preferences only, or in combination, and, after information of environmental impacts present new arguments; shifting focus to new levels of productivity/consumers, or a combination.

3.4 Changes in conceptions of how prices are determined and *should be* determined

This section examines differences between conceptions of how environmental issues *are* reflected in prices and judgments about how environmental factors *should be* reflected in prices.

We begin by comparing the categories of conceptions that we observe amongst this group of students. One similarity between students' utterances about how prices are determined and how prices should be determined was that they referred to productivity more than consumer preference. This similarity was present before and after the presentation of additional information. In addition, we observed no examples of complex conceptions of consumer preference either when students were thinking about the causation of price or what price should be.

However, when examined the utterances of individual students there seems to be little consistency. For example, Manfred made no reference to consumer preference either in T1 or T2 in his responses about how prices were determined. However, he referred to consumer preference when explaining how he believed price should be determined in T1 before and after receiving additional information. Before seeing the information he argued simply that consumers will buy whatever cheapest and therefore that eco-burgers should be cheaper. After seeing the information he articulated a logic for this position on the basis of externalities, although he did not express an idea of consumers internalising externalities. The significance of the relationship between beliefs about how prices are determined and how prices should be determined is illustrated by the interview extracts from Maria. Her conception of the role of productivity in determining price developed from basic to partial between T1 and T2. But she made no reference to consumer preference when asked to explain how prices were determined. However, she refers to consumer preference in each of her utterances about

how prices should be determined. By T2, before seeing the information, she expresses a conception of consumers internalising externalities ('if one thinks more of the effects from the emissions, one takes care of lots of things and that influences the price'). However, her utterance after seeing this formation in T2 indicates that her thinking about how demand affects price is problematic. She claimed that 'high demand reduces price'. She does not appear to have developed any clear view about how consumer preference switching between two products will affect their prices. These extracts, in the context of the whole set of responses suggest that everyday thinking about how prices are determined and how they should be determined develops along separate pathways and there is no automatic spill-over from development in one pathway on to development of the other. One implication is that teaching should explicitly help students to develop a coherent way of thinking about both questions. Economic analysis of policy responses to environmental problems emphasise the importance of market incentives (and the implications of their absence), so the development of students' grasp of the relationships between consumer preference and environmental problems is important for citizenship.

4. Summary of results

We have explored changes in upper secondary pupils' explanations of price in relation to the environment and found that almost all students (thirteen of fifteen) made connections once or repeatedly through time when thinking about how prices *are* and *should be* determined for eco- and regular beef-burgers. Students' different conceptual changes through the final years in school are summarized in the following.

What differences are there between students' conceptions of environmental issues in pricing after one further year of business and economic education in upper secondary school?

Economic and business studies aim to improve students' understanding of price by developing integrated thinking about supply and demand. We found only limited evidence of success in this objective in students' thinking about price in the context of environmental effects. We did find some indications of development in students' thinking about the impact of productivity on price. However, even those changes, which we did find, appeared to be still at an uncertain stage of transition from a more simple to a more *complex* way of thinking about price. The students in our sample were still struggling to integrate their thinking about productivity and their thinking about consumer preferences and we did not detect any firm steps being made towards stronger integration. Nonetheless, we believe our analysis has helped to clarify not only the different levels of understanding which students may display but also likely trajectories between these levels and the uncertainty attached to students' progress. We believe this evidence could help teachers to improve the effectiveness of their teaching and, thereby, the role of schooling in developing

an economically informed electorate (Davies, 2006; Davies, 2015). Findings, across a years' time, for how prices *are* determined show changes between levels of productivity where the characteristics of *partial* conception are essential for almost all students. Changes are from *basic* to *partial* and from *partial* to *basic* conceptions of productivity. Furthermore we found that five students once highlighted the levels of consumer preference as *basic* or *partial* conceptions however we did not find any changes between these levels over time.

What differences - before and after given information regarding environmental issues and after one further year of schooling - are there between students' explanations of how prices should be determined?

Besides exploring differences between conceptions of how prices *are* determined this study also explores differences between students' explanations of how prices *should* be determined. This interest concerns students' conceptual differences before and after they are given information, as well as changes regarding these explanations after one further year in the business and economic program. In the first year, two different views were revealed 'pre- and post-information'. The first illustrates how students before information associated (a) *consumer preference to influence pricing* and after information *highlighted productivity references* when asked how prices *should* be determined. The second change shows a shift from (b) *productivity as an argument before information, and after information, arguing for a price in relation to both productivity and consumer preference*. These various differences are represented by almost half of the students. The other students referred to the same price influencing mechanism before and after information, for instance to consumer preference for eco goods both before and after received information. Changes through one year show that (a) is consistent at group level however not fully at individual level and (b) is of a sporadic matter. This exemplifies that the provision of production-based information does not simply forces students to adopt a particular change of focus towards production. An important notion is that all students, except three, present various shifts in views of consumer preference and productivity, 'pre- and post-information', over time.

What differences are there between conceptions that are evident in student explanations of how environmental issues are reflected in prices and judgments about how environmental issues should be reflected in prices?

Results on students' conceptions of how prices are determined and preferences for how prices *should* be determined show that students show several different changes between the themes over time. It is important to underline that most students referred to productivity as a factor that has impact and *should* have an impact on the price (after given information about particular negative production impact) while consumers were connected to more frequently for how prices *should* be, before the information was given. However three

individuals did not follow this line of thinking over time. They once specified, after productivity information, a connection to consumer preference that *should* influence prices.

5. Discussion and conclusion

This study is conducted within the theoretical framework of conceptual change where the individuals' learning process is traditionally seen as changing from an initial understanding to a more scientific understanding of a phenomenon. In the light of this, questions have been raised about the coherence and stability of individuals' conceptions and the classic *replacement model* that imply that conceptual change is a liner-replacement-movement, from understanding A to understanding B, has been suggested to be incorrect. Research into science conceptual understanding has shown that parallel conceptions can co-exist and even contradict (Larsson & Halldén, 2010; Halldén et al., 2013; Shtulman & Valcarcel, 2012; Shtulman & Harrington, 2016).

This study aimed to describe how business and economic school students' conceptions of pricing in relation to negative environmental impact develop. We conclude on a rich conceptual variation of differences and changes over time and, as a consequence, this great variability is difficult to describe as "group" findings (Saldaña, 2003). However, we found that connections between environmental impact and price are commonly expressed with references to production costs and production externalities, as *partial* conceptions. We believe this illustrates students' conceptions in a process of change towards a more scientific conception of relationships between price and various environmental impacts. These conceptions appear to be the students' explorations of various circumstances - an elaborating approach - and they seem to be rational explanations (to students) of pricing for the moment. We believe that students expressing a *partial* conception explained important views of how environmental impact from production influences the prices, since the students highlighted productivity and also, in a tentative way approached externalities, by pointing to environmental costs, which is partly or not included in the price.

The conceptual changes concerning negative impact in relation to consumers show that more than half of the students (8 of 13) did not at any time make references to consumers' demand thinking. This may stem from an everyday conception which treats negative production externalities as entirely the responsibility of producers. Students' experience as consumers does not draw them into a sense of personal responsibility for production externalities which are prompted by market rather than individual demand. As noted by Lundholm & Davies 2013, "*Personal experience offers access to a very limited external context. A student's experience of the price of a drink they buy is restricted to their observation of selling. They do not have observational access to relationships between the seller and the market in which that seller operates. Neither do they have access to relationships between that market and other markets.*" (p. 300). This

points to a learning issue in that scientific conceptions sometimes only seem to be corresponding partly, or, they may even be perceived as contrary to one's everyday-understanding.

As mentioned, the link between environmental impact and consumer preference (by means of demand) is not frequently referred to or elaborated on (even if the interviewer repeatedly asked for additional descriptions of factors that are influencing price). We have not found a change across time that included this particular reference for how prices are determined. This makes us suggest that, in this study, the individuals' experiences of buying does not seem to be linked to buying eco-goods, even if almost all students said that they sometimes buy beef-burgers and when the interviewer added information about eco-version being more expensive the students were not surprised. Thus, in relation to the quote above, the students' experiences of purchasing a hamburger, eco or non-eco, do not provide them with information about the impact of demand on price. Here, it is worth noticing that negative environmental impact, is through time, associated with production processes and environmental costs caused by these. We see these results in the light of a mix of experiences and this suggests that environmental impacts is in a Swedish societal context mostly related to production methods i.e. the supply side of the market. Much attention is given to farming procedures, eco labelled goods and the offers from shops and supermarkets, compared to attention to consumer preference influencing prices. Further, media interest of the program of meat free school lunches, or specific instructions in school subjects, could direct students to a production-focus rather than consumer-focus. Some students in our study described for instance instructional sequences showing how international clothes manufacturing, by growing cotton with lots of pesticides, generate environmental negative impact.

Davies & Lundholm (2012) found examples of students' thinking about over-consumption which suggested that if prices are too low (for example for beef-burgers) more people would buy them causing negative externalities to the individuals in terms of health. Our results show that some students state that eco beef burgers *should* be cheaper so that more people will buy them. However, this is not the current situation. The normalizing effect, in relation to students' preferences for how prices *should* be, could suggest that there would be strong preferences for prices to remain as they always have been (i.e. eco *should* be more expensive) and one/two students suggested this. But, opposite to the current situation, most students preferred eco to be less expensive with arguments to get people to buy them, and post-information with arguments that less negative impact is generated from eco-goods. This can be influenced by education, suggesting how to influence people's choices by pricing. Perhaps is there in Sweden also a norm that is contrary to the English stating that 'eco goods are (too) expensive, and that is wrong'. That could then possibly

explain the results we have, in terms of normalizing effects.

The results of this study show that changes of conceptions and the learning process is not as straightforward as in moving from one aspect of production (supply), to understanding supply and demand in interaction. The results can therefore be discussed in terms of stability; why do students mention the environment in one interview, and not the other? Why is production and not demand talked of at one point and not another? This can be caused by the social or societal setting at large or by a previous educational experience. Briefly, contextual conditions are potential locations of participant change (Saldaña, 2003). However, changes of students' conceptual content is this study's main interest, rather than causes to individuals conceptual understanding, and the findings can also be seen as a result in itself; it is the fragmented and 'floating' pieces of information that students have gained and which they are exploring and 'trying out' in the interview situation. *"Conceptual change seems to be a process of tentative reorganization within different conceptual structures and with different explanatory contexts, and when these tentative reorganizations within different contexts take the form of a new gestalt, a conceptual change is in the process of occurring"* (Larsson & Halldén, 2010, p. 662). Our study has observed that students seem to embrace and elaborate a rich variation over time of how pricing and negative environmental impacts are linked. It also observed a variation expressed in terms of *basic*, *partial* and *complex* understandings of the links. An important result is that more than one aspect of conceptions, of environmental impact and pricing, at one particular time seem to be actualized to the individual.

The vast majority of studies within the research field of conceptual change focuses on students in science education and fewer have focused on students within the social sciences. In addition to assessing a less frequently investigated group of respondents, the study also takes into account two combined, and at the same time interdependent dimensions, namely topics and concepts in social sciences and environmental impact – the former expressed via the price conception and the latter represented by assumed negative consequences from production and consumption, for the environment, externalities. Furthermore, the study serves in addition to this field of research, basing its method on repeated interviews. Hence it addresses the formation of conceptions, presenting views during more than one occasion and with a timespan between them that allows for the respondent to develop along the educational program. The study is thus relevant for teaching and learning in both economic and environmental fields of education and its results highlight the importance of emphasizing the price concept for the understanding of the supply and demand terms of the market and the interaction of them. From the perspective of economic education the study shows that costs for environmental depletion and its relation to the market needs to be exemplified and described in closer detail. The results

also highlight the importance of underlining an economic context for thinking - where experiences might be insufficient or might lead the student in a wrong or false direction. Furthermore, we believe that environmental problems are important challenges for economic understanding, as it is obtained in schools, because it needs to clarify the nature of the interaction between the environment and the economic system. To make students aware of their initial conceptions of this connection is one way of doing this.

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Appendix

Climate change aspects of meat production

Climate aspects of meat production and consumption do not solely concern the emissions of greenhouse gases. Animal farming requires more energy than crop farming. It is, however, not animals that are the main problem. Rather it is a matter of the forms and location of the production of beef cattle that lead to environmental impact. Instead of a pasture based production, or similar, about 50 % of the crops grown in Sweden is used for dry fodder in animal production. When cultivating the crops, chemical pesticides and fertilizers are used on an almost regular basis and these impacts negatively on the conditions for wild animals and plants. This, in turn, means a reduction of biodiversity, as well as an increase of nature's vulnerability.

Sonesson, U., & Wallman, M. (2009). *Kött är mer än klimat - köttproduktionens miljöpåverkan i ett helhetsperspektiv*. Naturskyddsföreningen. Retrieved from www.naturskyddsforeningen.se/sites/default/files/dokument-media/2009_jordbruk_mat_kott_mer_an_klimat.pdf

Harmed environment from increased meat eating

According to a Swedish study, emissions are reduced when people eat eco-produced meat, from farming based on pasture and/or similar, rather than fodder crops that are cultivated primarily for animal feeding. Production of eco-friendly meat means 40% less emissions of climate impacting gasses and emits 85 % less energy, compared to production that is based on conventional farming.

Pelling, J. (2007, 26 July). Ökat köttätande skadar miljön. Svenska Dagbladet. Retrieved from www.svd.se/nyheter/inrikes/okat-kottatande-skadar-miljon_248685.svd